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The Culture of Greenhouse Chrysanthemums

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Chrysanthemums and Pompons in the Station Greenhouse

THE CULTURE OF GREENHOUSE CHRYSANTHEMUMS

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From early fall until well into December, chrysanthemums and pompons are the dominating flowers on the markets of Ohio. Most of these flowers are grown locally, and many are shipped out of the State. The majority of growers have some space devoted to them, while many have several acres of these crops. Chrysanthemum shows are a yearly event in many localities, and greatly stimulate interest in these flowers. Their comparative ease of culture, long keeping qualities, and showiness give them an important place among the commercial flower crops.

This bulletin is a preliminary report of the work being done at the Ohio Agricultural Experiment Station.

WHAT TO GROW

There is always a question in the minds of growers as to the relative amount of space to devote to chrysanthemums and to pompons. Market conditions change from year to year. For the last few seasons the demand has been poorer in late October and the first two weeks of November than at any other time during their season. Therefore early and late varieties have been a wiser choice. Western grown chrysanthemums for the early season markets nave become a factor to consider. A good assortment of colors, and a continuous crop thruout the season, with, perhaps, light production in midseason, would seem advisable at present.

TABLE 1.—Value of Chrysanthemums and Pompons

Crop	Varieties	Av. prices per season	Returns per 315 sq. ft.
		Dollars	*Dollars*
Chrysanthemums	Turner Chrysolora Glorious Golden Glory	2.49 per dozen	185.90
Pompons	Sunshine Golden Feather Mrs. Buckingham Bronze Buckingham	0.75 per bunch	129.99

The consensus of opinion is that pompons are a better paying crop than chrysanthemums. Under the average grower's conditions this would probably be true. In the fall of 1927 records were kept on identical benches of chrysanthemums and pompons, each

contained 315 square feet. Prices were averaged for the season for four wholesale markets, from which price reports were received four times each month. Table 1 gives the returns for these areas.

In figuring the price of pompons, the total number of shoots cut was divided by 25 to determine the number of bunches. Many of the bunches would not require 25 shoots of some of the varieties, which may account for the poor showing made by the pompons. Three-fourths of the chrysanthemums were grown to one flower per plant, the remainder to two flowers per plant.

If a grower has a rather high class market to supply, more chrysanthemums no doubt could be grown to advantage. A poorer class of trade would prefer the pompons. Each grower must more or less determine for himself, under his marketing conditions and culture given, the crop that is best suited to his conditions. More growers have trouble producing first class chrysanthemums than pompons but both crops will yield profitable returns under normal conditions if properly grown.

PROPAGATION

Commercial named varieties of chrysanthemums and pompons are propagated by cuttings. The cuttings are generally taken from the stock plants which were the flowering plants of the previous season and had been dug and held in a more or less dormant condition until wanted to produce the cutting material.

Chrysanthemum and pompon cuttings are taken from March to late June. If suitable conditions are provided for the cuttings and young plants, a more vigorous plant is obtained by early propagation. If the stock is potted into small pots, neglected as to watering and repotting, and the growth becomes hard and stunted, before it is set in the benches or beds, early propagated stock becomes less desirable than that propagated later. Early propagated stock can be topped when sufficient growth has been made after potting, and in this way more plants of scarce stock obtained. Early blooming varieties need to be propagated early to allow time for sufficient stem growth before the buds appear. Late bloomers should be taken later, or they will have to be pinched several times to prevent an excessive stem growth. Regardless of when the cuttings are taken or put into the benches or beds, the varieties bloom at approximately a given date. The cuttings should, therefore, be taken in sufficient time to get the desired number from the stock on hand, and to allow sufficient stem growth in the chrysanthemums and pompons and a sufficient number of breaks in the pompons.

Good cuttings consist of tips of the shoots from the stock plants that are from 3 to 5 inches in length. The growth should be firm and in a healthy growing condition. These cuttings are placed in the cutting bench in the usual way.

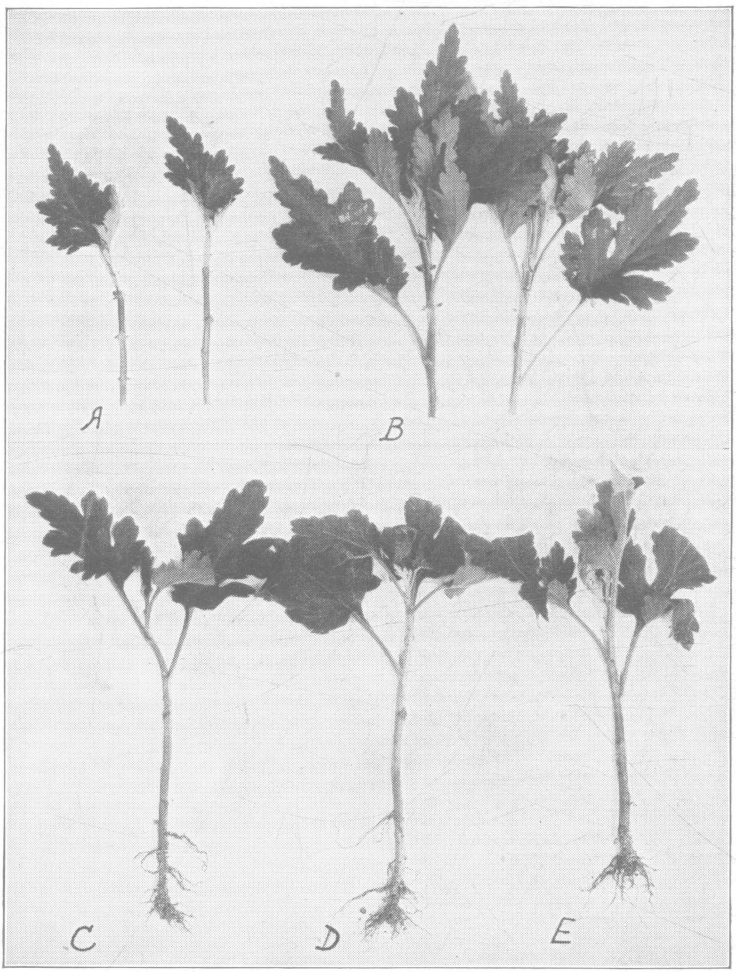

Fig. 1.—Cuttings ready for the cutting bench. (A) Trimmed, (B) Untrimmed, (C, D, and E) Cuttings at the proper stage to pot

In the spring of 1928 tests were made of the best media for rooting the various types of cuttings. Table 2 gives the results of this work on chrysanthemums and pompons. The average of all of the varieties in the different media are given.

It will be noted that there was little difference in favor of any one of the first three treatments. The average of all the treatments gave 95.9 percent rooting, and all were good. The care given the cutting bench has been found to be of more importance than the media used.

TABLE 2.—Media for Rooting Chrysanthemums and Pompons

Media	Number taken, all varieties	Number rooted, all varieties	Average percent rooting, all varieties
Slag	106	103.45	97.6
Sand	106	103.24	97.4
Sand and sphagnum	106	102.82	97.0
Slag and sphagnum	106	101.86	96.1
Slag and sand	106	101.12	95.4
Slag and peat	106	100.59	94.9
Sand	106	98.05	92.6
Sand and peat	106	98.05	92.6
Average			95.9

The cuttings should be placed in the cutting bench as soon after removal from the stock plant as possible to prevent wilting. They should receive one good watering to settle the medium around the stems when they are first placed in the cutting bench. After that water should be applied only as needed to prevent wilting. Shading the bench on bright days, particularly in late spring, helps to prevent wilting. The atmosphere should be kept moist, but not too moist. A bottom heat of 60 to 65° F. and air temperature around 50 to 55° F. are ideal. Chrysanthemums and pompons, however, are not hard to root and will start in a wide range of conditions.

TABLE 3.—Varietal Variation in Ease of Rooting

Variety	Number taken	Number rooted	Percent rooted
Yellow Turner	162	162	100.0
White Turner	189	185	98.2
Chrysolora	154	144	93.7
Golden Glory	126	126	100.0
Glorious	163	143	87.5
Mariana	100	98	98.5
Blanche	110	91	82.9
Bronze Buckingham	160	157	98.6
Mrs. Buckingham	172	150	87.2
Average			94.0

Some variation was noted among the different varieties in regard to the ease in which they rooted. Table 3 gives a list of some of the varieties to show this variation.

Among those listed, the variety Blanche, a white pompon, was the lowest in percentage of rooted cuttings. This was true in all of the nine treatments, which are averaged in Table 3. Blanche is what could be termed a "hard" grower, and does not "break" readily when pinched. Apparently this characteristic is also carried in the cuttings to the extent that roots are produced with difficulty. It would be advantageous for growers to know something of this characteristic of a variety, before the cuttings are taken, in order to better determine the number required.

The cuttings should root sufficiently to be taken from the cutting bench in from 3 to 4 weeks. They should be potted, regardless of time in the cutting bench, when the roots are from one-half to one inch in length.

POTTING THE ROOTED CUTTINGS

Chrysanthemum and pompon cuttings are potted in a manner similar to that of a majority of newly rooted cuttings. The pots commonly used are 2¼ or 2½ inches. The soil to be used is not as important as with some crops. However, a good loam that is not too rich nor too heavy is preferable.

The young plants from this point on are grown in about the same conditions as in the benches or beds. One very important point that should not be neglected is that the young plants should not be allowed to become pot-bound while in the small pots. Figure 2 shows two roots of the same variety taken from the beds after blossoming. It will be noted that the smaller root system grew out of the original pot-bound ball a very little if at all. The larger root is that of a plant which had not become pot-bound before it was placed in the bed where it was to flower. First quality chrysanthemums or maximum yields from pompons cannot be secured from plants that have been neglected while in the small pots.

Some growers plant the benches or beds with plants from the 2¼ inch pots. If the cuttings are not taken too early and the plants are set in the beds or benches early in the season, this practice is satisfactory. If the plants are becoming pot-bound in the small pots, and the area where they are to be set is still in a late spring crop, other steps are necessary to hold the young plants in a good growing condition. One method is to repot into larger pots, while another method is to set them in the field, where they are grown similar to carnations, until they are benched. The latter method is common, particularly in the case of Mistletoe or other

late varieties that are not necessarily benched very early. Any method is satisfactory that will keep the young plants growing in a healthy way, and that allows sufficient space for normal development of both tops and roots.

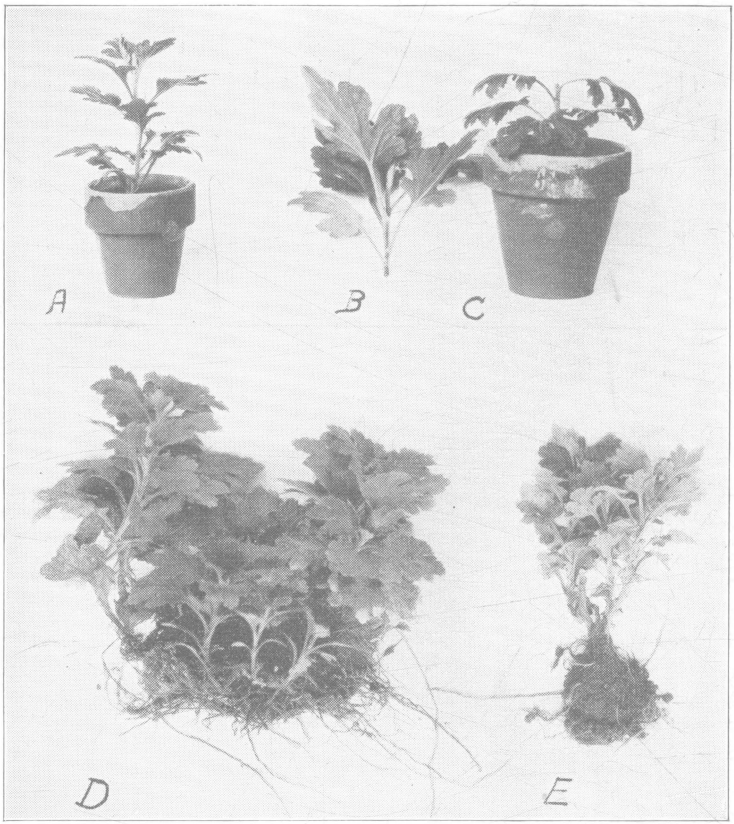

Fig. 2.—(A) A good cutting growing off in a 2¼ in. pot. (C) Plant raised to 3 in. pot with tip. (B) Removed for cutting. (D) Roots of plant taken from bed that had not been allowed to become pot-bound. (E) Same variety that had been allowed to become pot-bound.

RAISED BENCHES OR RAISED BEDS

White's "Principles of Floriculture" recommends the use of raised benches for growing chrysanthemums and pompons. Fritz Bahr's "Commercial Floriculture" recommends raised benches for chrysanthemums and either benches or beds for pompons.

Table 4 gives the average diameter and stem length for eight plots grown in a bench and eight grown in raised beds with an 8-inch cement curb to outline the walks but with no artificial bottom, the soil resting on the ground. White Turner was the variety grown, 72 plants to a plot.

TABLE 4.—Raised Benches vs. Raised Beds for Chrysanthemums

Plot	Average diameter		Average stem length	
	Raised bench	Raised bed	Raised bench	Raised bed
	In.	*In.*	*In.*	*In.*
1	5.2	5.8	45	53
2	5.2	5.8	43	55
3	5.2	5.7	42	54
4	5.0	5.5	42	54
5	5 1	5.5	44	51
6	5.7	5.8	45	49
7	5.7	6.1	46	51
8	5.4	5.6	44	50

Table 4 shows that in every plot both the average diameter of blossom and average stem length were better in the raised beds. The authors of the articles mentioned and practically all writers on chrysanthemums and pompons state that they are "heavy feeders", and that they require an abundance of water. It is a well known fact that soil in beds retains moisture much longer than in raised benches, and plant foods are not so quickly leached from the soil. Chrysanthemums and pompons, if grown in raised benches, are in this soil during the hottest months of the year, when it is difficult to keep the soil properly moistened at all times. General observation, and the figures in Table 4 should be convincing proof that chrysanthemums can be grown as well, if not better, in raised beds as in raised benches.

Table 5 gives the corresponding figures for three varieties of pompons.

As with the chrysanthemums, the pompons in the beds were invariably better in both the average number of shoots per plant and the average stem length.

The growing conditions to which both the chrysanthemums and pompons were subjected might favor the beds over the benches. Another grower under other conditions might get a reversal of results. However, these results are conclusive enough so that we believe both chrysanthemums and pompons can be grown to a better state of development on beds, with the average care given them. Less water is required and applications of plant food materials do not have to be made so often.

TABLE 5.—Raised Benches vs. Raised Beds for Pompons

Variety	Plot	Average number shoots		Average stem length	
		Raised benches	Raised beds	Raised benches	Raised beds
		No.	*No.*	*In.*	*In.*
Blanche	1	8.3	12.3	25.2	34.4
	2	9.6	11.0	25.4	34.6
	3	7.8	12.1	28.8	32.3
	4	8.1	10.9	25.3	30.2
	5	8.7	13.3	26.0	30.5
	6	9.8	12.4	25.5	32.6
	7	9.1	12.3	27.0	31.3
Mariana	1	4.0	5.6	18.9	27.0
	2	4.3	5.9	16.7	29.0
	3	2.7	6.6	15.7	31.0
	4	2.7	6.6	17.3	26.0
	5	3.8	6.4	17.8	28.0
	6	3.8	7.3	16.7	32.0
	7	4.8	8.1	17.0	32.0
Sunshine	1	4.6	11.4	15.0	24.9
	2	4.6	10.1	16.0	24.7
	3	5.3	11.7	15.0	25.0
	4	5.1	10.6	18.0	23.5
	5	4.5	11.9	15.0	25.0
	6	5.1	13.6	16.0	24.0
	7	5.0	12.3	18.0	25.0

CHANGING THE SOIL

The author published a report in the July-August, 1928, Bimonthly Bulletin of the Experiment Station on the effect of old and new soil on chrysanthemums and pompons. This work has been continued and in June, 1928, another one of the raised beds in the Station greenhouses was filled with a freshly composted soil, from another source than that used in the test described above. This bed was planted with chrysanthemums and pompons and a bed that had grown these crops as well as other cut flower plants for three years previous was set to the same varieties, after it had been steam sterilized, and a light application of fresh, coarse manure worked into it. Table 6 gives the results of the 1927 tests with chrysanthemums while Table 7 gives the 1928 results. The

TABLE 6.—Chrysanthemums on Old and New Soils, 1927

Variety	Average diameter old soil	Average diameter new soil	Average stem length old soil	Average stem length new soil
	In.	*In.*	*In.*	*In.*
Chrysolora	6.1	6.1	36	39
Golden Glory	5.9	5.6	23	35
Glorious	5.9	6.0	31	33
White Chieftain	4.2	4.1	29	32
Pink Chieftain	4.6	4.5	31	35
Thanksgiving Pink	5.1	5.3	34	39
Louise Pockett	5.8	6.5	39	44

1928 tests were conducted in the same manner as the 1927 tests, only the old soil was one year older, and the compost used as "new soil", was much richer in plant food in an attempt to increase the value of "new" soil over "old", if it were a question of plant food.

TABLE 7.—Chrysanthemums on Old and New Soils, 1928

Variety	Average stem length old soil	Average stem length new soil	Advantage for changing soil
	In.	*In.*	
Mrs. R. M. Calkins	44.6	43.5	−
Rosa Raisa	37.0	41.8	+
Nerissa	46.0	49.1	+
Sun Glow	46.3	47.0	+
December Glory	54.1	53.9	−
Dr. Enguehard	49.5	51.2	+
White Mistletoe	51.9	45.9	−
Detroit News	48.3	45.6	−
Mrs. J. Leslie Davis	49.5	50.7	+
Gladys Pearson	55.2	51.2	−
Golden King	52.2	47.1	−
Louise Pockett	48.0	48.0	0
Harvard	25.0	45.0	+
Wm. Waite	41.5	41.8	+
Chrysolora	44.0	37.7	−
Golden Glory	37.5	33.9	−
Glorious	35.8	34.5	−
Pink Turner	52.7	45.7	−
Harvard	49.0	43.0	−
Miss Chicago	56.3	50.9	−
Indianola	45.9	43.1	−
Thanksgiving Pink	40.0	37.0	−

As seen by Table 6, there was no consistent gain or loss in the diameters of the blossoms on old or new soil. Old soil and new soil each gave larger blossoms with three varieties, and with one variety there was no apparent difference.

New soil gave an increase in stem length on all varieties for the season 1927. As the old soil gave stems sufficiently long for commercial purposes, no economic reasons would warrant changing the soil at the end of the third year, under the conditions of this test.

The results in Table 7 substantiate to a greater degree the 1927 conclusions. Diameters of the blossoms were not recorded in 1928 as in 1927. The diameters did not show consistent results, and recording diameters has not been found reliable at Wooster. Diameter is governed to a large degree by the maturity of the flower. Altho an attempt was made to record the flowers at a given state of maturity, a great deal of error entered into these measurements.

Twenty-two varieties of chrysanthemums were used and only stem lengths were recorded. The old soil gave better results with fourteen and the new soil with seven of the varieties. On one variety the stem length averaged the same on the old and new soils.

These results would seem at first contradictory to those secured in 1927. When the soil used is considered we do not feel this to be the case, however. In an attempt to get a very rich soil, the compost used in 1928 was prepared from nearly half and half cow manure and blue grass sod. When the plants were put in the new soil little growth was made for the first 6 to 8 weeks, and, due to an excess of plant food, the foliage did not appear extremely healthy. In the meantime the plants in the old soil gained a big advantage. When the excess food was used or leached out the plants in the new soil started to grow luxuriantly and in some cases before the end of the growing period, as the records show, grew taller than the same varieties in the old soil. By applying fertilizers to the fertilizer plots the same conclusion was apparent, namely, that poorer growth was obtained when too large a quantity of certain plant food materials was present when the plants were first set.

The 1928 figures show that where steam sterilization is available, soil that has grown chrysanthemums and general cut flower crops for three previous seasons in raised beds is satisfactory for the fourth crop. In addition it would not be advantageous or economical to change the soil.

Tables 8 and 9 give the 1927 and 1928 results from pompons on the old and new soils.

TABLE 8.—Pompons Grown on Old and New Soils, 1927

Variety	Av. number shoots		Av. length of stem	
	Old soil	New soil	Old soil	New soil
Golden Feather	5.8	7.1	22	23
Blanche	5.6	5.4	22	22
Mariana	3.3	3.7	18	19
Bronze Buckingham	5.1	5.3	12	16
Mrs. Buckingham	4.8	5.4	14	16

Table 8 shows that the new soil gave an increase in average number of shoots per plant in four out of five varieties in 1927. The new soil also gave an increase in the average stem length with four varieties. The old and new soils were equal in the case of the fifth variety. As shown in the Bimonthly Bulletin article, already referred to, the increase in yield of shoots per square foot in favor of the new soil would give an increased profit of 1.6 cents per square foot. Soil cannot be composted and changed for this figure.

Table 9 shows that the new soil produced a greater average number of shoots per plant in only four varieties, was poorer than the old soil in six varieties, and was equal in one variety in 1928. The new soil gave an increase in stem length on only two varieties and was poorer than the old soil on nine varieties.

TABLE 9.—Pompons Grown on Old and New Soil, 1928

Variety	Av. number of shoots		Av. length of stem	
	Old soil	New soil	Old soil	New soil
	No.	*No.*	*In.*	*In.*
Old Gold	7.5	7.6	30.0	31.7
Angelo	11.9	11.4	35.0	27.7
Red Beu	6.4	6.2	31.5	28.0
Varsity	6.8	8.1	32.3	26.0
Izola	9.8	9.7	36.0	35.0
Jane Ingalls	9.1	9.1	35.7	33.0
Minong	11.0	9.9	32.0	29.0
Lustra	8.2	9.1	28.0	29.0
Golden Feather	7.4	6.9	35.1	31.9
Sunshine	7.7	7.0	30.4	24.4
Christmas Gold	2.4	3.2	29.0	24.0

The same compost was used as that applied to the chrysanthemums in 1928 and the excessive plant food it contained was no doubt the cause of the extremely poor showing the new soil made. It will be seen from the yields of the old soil plots that the change of soil was not necessary.

Where steam sterilization is available and where beds are used for growing, it is apparent that, as was true of the chrysanthemums, it is not necessary to change the soil at the end of the third season for pompons. Sweet peas, snapdragons, and calendulas have followed the chrysanthemums and pompons with satisfactory crops to date, which would make the foregoing statement true in regard to them as well.

In the case of raised benches an entirely different situation is encountered, as a satisfactory and economical method of sterilization for benches has not been developed. The greater loss of humus from raised benches, is also an important factor.

SOIL REACTION

Chrysanthemums and pompons have been grown for two seasons in a wide range of soil reactions. Plots that were relatively high in either acidity or alkalinity and intermediate plots were set with chrysanthemums and pompons in order to determine the soil

reaction which produces the best commercial growth. Table 10 gives the results of these tests on the chrysanthemums. White Turner in 1928 and Harvard in 1927 were the varieties used, 12 plants being grown to a plot.

TABLE 10.—Effect of Soil Reaction on Chrysanthemums

Plot	pH value	Comparative reactions	1927		1928	
			Diameter	Stem length	Diameter	Stem length
			In.	*In.*	*In.*	*In.*
1	5.0	Very acid	5.1	37	5.25	45
2	5.5	Acid	5.1	36	5.25	43
3	6.0	Moderately acid	5.5	35	5.25	42
4	6.5	Slightly acid	4.8	34	5.04	42
5	7.0	Neutral	5.2	37	5.12	44
6	7.5	Slightly alkaline	5.2	34	7.7	45
7	8 0	Moderately alkaline	4.6	36	5.7	46
8	8.5	Alkaline	4.8	36	5.4	44

Very little preference was shown in the diameter of the blossoms or in stem length for the treatments given.

Table 11 gives the results on the pompons. Sunshine was grown in 1927 and the Blanche and Mariana in 1928. Twelve plants of the pompons were grown to a plot.

The pompons it will be noted acted in a manner similar to the chrysanthemums. They did not show any particular preference for acid or alkaline conditions within the range tested. The range in pH value from 5.0 to 8.5 covers all of the different growing soils that have been tested in Ohio. Unless extreme applications of lime or other materials are added, the soil does not often test outside of this range.

TABLE 11.—Effect of Soil Reaction on Pompons

Plot	pH value	Comparative reaction	Sunshine		Blanche		Mariana	
			Shoots	Stem length	Shoots	Stem length	Shoots	Stem length
			No.	*In.*	*No.*	*In.*	*No.*	*In.*
1	5.0	Very acid	4 6	10	8.3	25	4.0	18.9
2	5.5	Acid	4.6	11	9.6	25	4.3	16.7
3	6.0	Moderately acid	5.3	10	7.8	25	2.7	15.7
4	6.5	Slightly acid	5.1	13	8.1	28	2.7	17.3
5	7.0	Neutral	4.3	10	8.7	25	3.8	17.8
6	7.5	Slightly alkaline	4.5	10	9.8	26	3.8	20.8
7	8.0	Moderately alkaline	5.1	11	8.0	25	4.8	16.7
8	8.5	Alkaline	5.0	13	9.1	28	5.1	17.0

The flowers on the most alkaline plot (pH 8.5) turned brown on the outside tips of the petals, which made them unsalable. Outside of this one plot no differences were noted in the quality or keeping quality of the flowers from the several treatments. How-

ever, a chlorotic condition is often noticed in the leaves of chrysanthemums growing in very alkaline soil, whereas those in an acid soil are dark green and of a healthier appearance.

PLANTING DISTANCES

Planting distances vary for chrysanthemums and pompons, the latter requiring more space for proper development than the average chrysanthemum.

Chrysanthemums should be spaced around 8 inches for extra large varieties, or where more than one flower is grown to a plant a greater distance would be required for some varieties. A small variety, such as Chrysolora, can be set less than 8 inches. If a grower obtains greater returns from a larger number of blossoms of slightly poorer quality, than from a smaller number of first class blossoms, this would favor the closer setting. Space enough should be given each variety to allow it to develop a good supply of foliage, and to allow for cultural operations such as spraying, disbudding, and tying.

Pompons should be spaced from 9 to 15 inches depending on the variety and culture. Weak or small growing varieties such as Mariana or New York, do not require as much space as Golden Feather or Mrs. Beu. Pompons disbudded and grown to 4 or 5 shoots do not require as much space as those with several more shoots.

In the July-August 1928 Bimonthly Bulletin of the Station the author has an article on the spacing of pompons. The results of one year's work show a tendency for the closer spacings to give better returns per square foot than the wider spacings. Varieties and general culture play an important role in determining the most profitable spacing.

Where growers pay close attention to disease and insect prevention, and give the crops good cultural conditions, close planting proves more profitable in many cases, whereas, under the opposite conditions a great deal of the crop may be lost.

SETTING THE PLANTS

The proper time to set the plants in the benches or beds depends on the variety, condition of stock, and the crops grown in the houses. From June 1 until July 15 should cover the majority of cases. Early flowering varieties, such as Yellow Frost, should be set early in June if a good stem is expected. Mistletoe can be set in July and there are cases where it has been set later than July and still produced stems long enough for first grade flowers.

If the young plants are becoming pot-bound or they are in need of further spreading, they can be benched at any time that other crops are not occupying the space that has been prepared for them. If plants are benched too early the stems make an excessive growth, which is difficult to support properly and which is of no advantage. Growth of both chrysanthemums and pompons can be pinched until a proper time for them to make a desirable stem growth. Plants set early seem to do better on the average than later set plants.

Plants should be moved to the permanent bench or bed with the least possible chance for them to wilt. On cloudy or rainy days conditions are much more ideal; and if one can set them on cloudy days or in the late afternoon, no wilting should occur with pot-grown plants. They should be set at approximately the same depth that they were grown in the field or pots, but this is not as important as with carnations. The ordinary precautions as to firming the soil and immediate watering should be taken.

TRAINING CHRYSANTHEMUMS AND POMPONS

Training chrysanthemums and pompons depends on when the cuttings were taken, how they are to be grown, and the varieties.

Chrysanthemum cuttings of very early varieties taken in late March, grown in 2¼-inch pots until early May, and then placed in the permanent benches or beds and grown to a crown bud and a single flower to a plant would not require any pinching. If the cuttings were taken too early, if more than one flower is wanted to a plant, or if the variety does not make good blossoms when grown to a crown bud, the chrysanthemums will need pinching.

Pinching has been found a good means of checking chrysanthemums and avoiding excessive stem growth if the cuttings were taken too early. Pinching the young plants causes them to send out two or more breaks under normal conditions, the better of which can be selected where it is desirable to grow more than one blossom to a plant. Removing the crown bud and selecting terminals for flowering is really a form of pinching. It is the practice with chrysanthemums to remove all the lateral buds as they appear, allowing only the crown or terminal bud to remain on the flowering shoots. Chrysanthemum variety catalogues generally state whether a variety makes a better blossom from a crown or terminal bud. It has been our experience that, with the exception of a few very early varieties such as Early Frost, crowns are not so satisfactory as terminals. In fact many varieties do not make a

satisfactory flower from crown buds and the flowers do not hold up nearly as well after cutting. If a grower is not sure of the proper bud to take, he will be much safer in selecting a terminal.

The proper date for selecting the terminal is also given in the variety catalogues. A general rule for selecting or "taking" the terminal bud, as it is commonly called, is to wait until a whole cluster of buds appears at the end of the growing shoot. The central one is usually selected and the others removed. Crown buds appear much earlier than terminals and there can be no question regarding this bud, since the upward growth of the plant ceases when this bud is allowed to remain, and there are no leaves surrounding it.

The question of growing one or more blossoms to a plant with the chrysanthemum seems to depend on local conditions and the grower. In the fall of 1928 two flowers per plant were allowed to grow on one lot of 72 Yellow Turner plants, while another lot of the same number of plants was grown to one flower per plant under the same growing conditions for checks. The stems were about 2 inches longer on the plants grown to two flowers per stem. Apparently, due to the more shaded conditions the growth was greater but much more slender. The diameter of the flowers was one or more inches less in the case of the two-flower plants. Many of these went as first grade flowers, however, while around one-fourth were very much smaller than the blossoms on the one-flower plants. It is concluded from this test that where there is a market for first grade flowers it would be unprofitable to grow more than one flower to a plant. Where the market cannot consume such a large proportion of high priced stock, if two flowers were grown to a plant they could be sold at a lower price per dozen, and the unit area of glass made to yield as good returns as where the larger flowers were grown. Again some may have difficulty growing one flower to a plant to perfection, due to poor fertilization and general culture. It would be folly for this type of grower to attempt more than one flower per plant. Only the better growers will find it profitable.

In the Bimonthly Bulletin of July-August, 1928 there is an article on "Date of Pinching Pompons". It is much more important that pompons be pinched than chrysanthemums as several shoots are necessary for a pompon to make a profitable plant. The general practice is to keep pinching the shoots when they have developed to a sufficient size, from the time the cuttings start growth in the 2¼-inch pots up to a time that is sufficient for the

variety to have made the proper stem development before blooming. Pompons will bloom at approximately a given date regardless of how they have been trained if held at a certain temperature. Running them cooler will, of course, delay the blooming period somewhat.

There can be no set rule given as to the best date to stop pinching pompons. As is shown in the article mentioned this is a varietal consideration that a grower must determine under his particular conditions.

Generalities concerning the pinching of pompons can be given however. Pinching must be practiced to obtain a large number of shoots per plant. Pinching can be used as a means of preventing excessive stem development which is difficult to support. Pinching increases the number of shoots per plant but excessive pinching has a tendency to reduce the number of flowers per plant; thus giving fewer flowers per shoot and shoots of a poorer quality. Better results were secured when pinching was discontinued relatively early. With the majority of varieties it should be discontinued sometime during the month of August. Some hard growing types, such as Mariana and New York, have to be pinched with care or too few shoots per plant and an abundance of blind wood result.

SUPPORTS

Chrysanthemums and pompons are grown with some kind of supports to insure straight stems.

Chrysanthemums are supported by bambo canes, wire rose stakes, or by twine that is attached to an over-head wire running parallel to the rows and to which the plants are tied. To these supports the stems are tied at intervals, usually with raffia, being careful not to tie them tight towards the end of the season as the flowers are often deformed by being tied too near the support.

Pompons may be supported by several methods, and in some instances where the stems are short and upright no supports are used. A satisfactory method commercially is to run a wire down each side of the bench or bed and one or two in the bed. Cross pieces of twine are run between these three or four wires at intervals. If the pompons are tall and weak, every 10 inches will be none too close for the cross ties, while with stronger growers they can be spaced farther apart.

There should be two or three layers of this wire and twine supports, depending on the length of the stems. Unless sufficient support is given the pompons the plants will lodge in the benches

or beds, and crooked stemmed, poor quality flowers will result. It is economical of labor to place these supports before the plants have grown very large.

Rigid end bracing and rigid wires aid materially in securing a first class job.

WATERING

Chrysanthemums and pompons require a relatively large amount of water. They make a great deal of their growth during the hotter months when it is necessary to apply large amounts of water. At no time during their growth should they be allowed to become real dry. Neither should they be kept wet for any period of time, lest leaf troubles and root rot appear. A moist, but not wet, soil at all times is the ideal soil condition.

Syringing is resorted to during the bright hot weather, to reduce the temperature, hold red spider in check, and to create a moister atmospheric condition, which is more satisfactory for their growth. Syringing should be discontinued when the buds show color. After cool weather sets in in the fall, syringing should be done only at such times of the day as will leave the foliage dry at night. Otherwise mildew may develop to serious proportions.

TEMPERATURES

Chrysanthemums and pompons are relatively cool loving plants, tho a great deal of their growth is made during the hot weather. During most of their growth it is impossible to govern the temperature accurately.

They should be grown as close to 50 to 55° as possible for best results. If one wishes to hold back the blossoming date for the later varieties they can be run a bit cooler, and vice versa.

FERTILIZERS

Chrysanthemums and pompons are generally classed as heavy "feeders". The majority of authors recommend fairly heavy and continuous fertilization up to the time when the buds show color, when it should be discontinued because it is supposed to cause soft textured flowers.

Preliminary fertilizer tests were carried in the Station greenhouses during the seasons of 1927 and 1928. Only the common fertilizers used in greenhouse fertilization were tried to determine the comparative value of the more important elements. Substitutes for manure for modifying the soil, time of application of

fertilizers, and carriers are also being tested. The results of the work to date are shown in Table 12 for the Yellow Turner variety, but in every case the White Turner results were comparable.

As will be noted from Table 12 only stem lengths were recorded in 1928. As diameter of blossoms depends on how far the blossoms have expanded, it was felt that a great deal of error was possible in recording diameters. Some treatments had a slight tendency to delay maturity, and altho diameters were recorded at several different times in order to have the blossoms at a uniform state of maturity, a great deal of variation was possible. All of the blossoms in the 1928 crop were of good commercial size. It is thought that the response of the plant to fertilizers is well shown in the average stem lengths.

TABLE 12.—Chrysanthemum Fertilizers

Bed and plot	Treatments	Fertilizer per acre	Diam. of blossoms 1927	Stem length 1927	Stem length 1928
			In.	*In.*	*In.*
Bed 1—1	Cow manure	30 tons	5.5	37	52.1
2	Cow manure Bone meal	30 tons 1500 lb.	5.4	37	51.6
3	Bone meal	1500 lb.	5.2	35	51.1
4	Check	.....	5.3	34	49.1
5	Straw mulch Nitrate of soda	300 lb.	5.4	33	51.9
6	Straw mulch Comp. 3-12-4	1 ton	5.4	32	50.2
7	Straw mulch Superphosphate	1000 lb.	4.9	32	51.1
Bed 4—1	Sulfate of ammonia	260 lb.	5.1	43	55.5
2	Superphosphate	1000 lb.	5.2	40	54.2
3	Superphosphate Air-slaked lime	1000 lb. 1 ton	5.2	40	54.9
4	Vigoro	1000 lb	5.3	39	51.9
5	Comp. 3-12-4	1 ton	5.5	39	49.9
6	Peat Comp. 3-12-4	5 tons 1 ton	6.0	41	51.8
7	Slag Comp. 3-12-4	60 tons 1 ton	5.5	40	50.2
8	Check	.. ..	5.3	33	50.3

For the years 1927 and 1928 sulfate of ammonia gave the longest stems. Peat and a complete fertilizer, superphosphate, superphosphate and air slacked lime, cow manure, and straw mulch and nitrate of soda all gave good results. In 1927 new straw was applied to Plots 5, 6, and 7 in Bed 1, causing an apparent check in

growth soon after it was applied. In 1928 well rotted straw was applied, and the growth was decidedly improved. It is apparent with flowers as with other crops, that fresh straw in decomposing takes nitrates from the soil in competition with the plants. The use of rotted straw or applications of nitrogenous material to the fresh straw will overcome this difficulty.

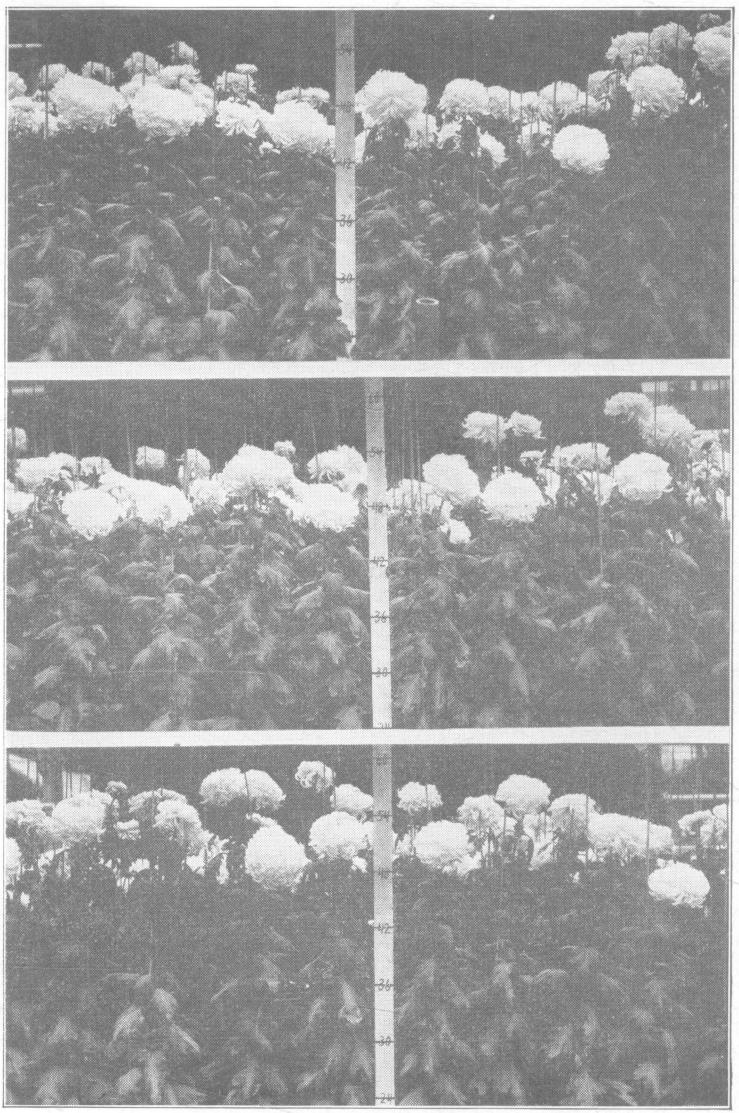

Fig. 3.—(Top) No fertilizer in addition to the cow manure worked into all plots before sterilization. (Middle) Straw mulch and nitrate of soda. (Bottom) Sulfate of ammonia

Quite a difference in color of foliage and general appearance of the plants was noted in the different treatments. Wherever nitrogen was applied, the foliage had a darker green color and a better texture. The stems were inclined to be slightly smaller in diameter, a condition which superphosphate apparently overcame.

As a soil modifier, peat moss seems to be decidedly promising. The soil that had peat mixed with it held water better, and was more friable than that of the cow manure plots.

TABLE 13.—Time of Application of Fertilizers for Chrysanthemums

Bed and plot	Treatments	Amounts per acre	Stem length		Best time to apply
			Applied before setting	Applied 6 weeks after setting	
			In.	*In.*	
B 1—1	Cow manure	30 tons	51.2	52.9	After
2	Cow manure Bone meal	30 tons 1500 lb.	50.2	51.8	After
3	Bone meal	1500 lb.	50.1	51.6	After
4	Check	.....	48.6	47.9	.....
5	Straw mulch Nitrate of soda	..... 300 lb.	51.1	53.8	After
6	Straw mulch Comp. 3-12-4	..... 1 ton	49.0	52.0	After
7	Straw mulch Superphosphate	..... 1000 lb.	50.9	51.7	After
B 4—1	Sulfate of ammonia	260 lb.	56.5	55.1	Before
2	Superphosphate	1000 lb.	56.7	53.2	Before
3	Superphosphate Air-slaked lime	1000 lb. 1 ton	53.8	52.7	Before
4	Vigoro	1000 lb.	54.5	49.1	Before
5	Complete 3-12-4	1 ton	50.7	49.7	Before
6	Peat Comp. 3-12-4	5 tons 1 ton	51.6	51.7	After
7	Slag Comp. 3-12-4	60 tons 1 ton	50.0	51.5	After
8	Check	.....	49.2	49.4	.....

The plots were 6 by 7 feet. Each one had 40 pounds of cow manure worked into the soil before sterilization. This fertilizer test merely indicates the treatments that florists might find profitable in addition to the good soil they have in the houses.

As to different times of application only two were possible under the limited space. In 1928 the plots were divided lengthwise, and one-half the area had the fertilizer mixed with the soil previous to setting the plants, while the other half had the fertilizer applied

6 weeks after setting. Table 13 gives the results of these two different times of application. Both White and Yellow Turner varieties are figured in these results.

Plots 2 and 4 in Bed 4, superphosphate and Vigoro, showed the greatest difference from the different times of application. Both favored applying the fertilizer before setting. However eight treatments favored applying after setting while only five favored the applications before setting. These results are far from conclusive, but tend to substantiate the old theory, that superphosphate or slowly available materials should be applied before setting while many of the quickly available materials should be applied afterward, when the plants have started growth and can make better use of the materials. This work is being continued with a greater number of different times of applying the fertilizers.

TABLE 14.—Pompon Fertilizers, 1928

Bed and plot	Treatments	Amount per acre	Average number shoots per plant all varieties	Average stem length all varieties
			No.	*In.*
Bed 2—1	Cow manure	30 tons	10.35	27.2
2	Bone meal	1500 lb.	11.0	26.9
3	Cow manure Bone meal	30 tons 1500 lb.	10.75	26.8
4	Check	....	11.72	25.7
5	Sheep manure	7.5 tons	12.12	27.2
6	Straw mulch Superphosphate	1 ton	10.08	28.4
7	Straw mulch Complete fertilizer	1 ton	9.48	26.6
Bed 3—1	Cow manure	30 tons	12.33	27.4
2	Cow manure Bone meal	30 tons 1500 lb.	12.68	26.6
3	Bone meal	1500 lb.	13.01	27.3
4	Check	....	12.52	26.0
5	Nitrate of soda	300 lb.	13.46	28.1
6	Superphosphate	1 ton	13.46	27.1
7	Complete fertilizer	1 ton	13.63	25.4

Table 14 gives the treatments, amounts, and results of the fertilizers on the pompons for 1928. Two rows of Mrs. Buckingham, two rows of Bronze Buckingham, two rows of Blanche, and one row of Mariana and one of Isotta were in Bed 2. One row each of Golden Feather, Sunshine, Aletta, Minong, Izola, Jane Ingalls, Golden Lida Thomas, and Mrs. Beu were in Bed 3.

It will be noted in this table that the treatments overlapped somewhat. Snapdragons followed the pompons in Bed 2, while Calendulas followed in Bed 3, which accounts for this overlapping of treatments.

All of the treatments were better than the checks, with the exception of Plot 7 in Bed 3, in regard to stem lengths. There was a tendency for the treatments that gave the best stem length to produce the smallest number of shoots per plant and vice versa. In general, the pompons did not respond to the fertilizer treatments as well as the chrysanthemums.

As with chrysanthemums, stem length is regarded as the best indicator of the benefits derived from the treatments, as the large shoots were ordinarily of superior quality. Therefore nitrate of soda, and the well rotted straw mulches would seem to be the best treatments.

Nearly all texts and articles on chrysanthemums recommend weekly applications of fertilizers either from a few weeks after setting or from the time the buds show, up until the buds show color. With the treatments given all of the plants were above the average in growth made, and the results indicate that these crops do not need feeding as regularly and at as short intervals of time as has been recommended. It is true that chrysanthemums and pompons are heavy feeders, but in good soil in beds, one, two, or three applications of fertilizer should carry the crops thru to maturity. In benches the crops may need to be fertilized oftener.

No appreciable differences were noted in the keeping quality of the flowers from the several fertilizer plots. The manure, and manure and bone meal plots tended to blossom earlier, while the plots receiving treatments of soluble nitrogen tended to blossom later, but these differences were not marked, and all of the plots were at their height of bloom at about the same time.

CUTTING THE BLOSSOMS

Chrysanthemums in particular deteriorate or "go down" rapidly if they are cut before they are well matured. An immature blossom will go down in four or five days, whereas a blossom that has been allowed to expand on the plant will hold up much longer. Practically all of the petals in the blossom should be well expanded before they are cut.

Pompons can be cut at a much earlier stage of their growth and still mature satisfactorily. Market conditions govern to a large degree the time when pompons are cut.

Fig. 4.—(2) The proper stage to cut chrysanthemum blossoms. (1) Not sufficiently expanded

STOCK PLANTS

Chrysanthemum and pompon roots are usually dug as soon as the flowers are cut to allow for the other crops that follow. A number of each variety that the grower wishes to continue must be saved for "stock plants", or plants from which the cuttings for the next year's crop are to be grown.

In horticultural work there is a great deal of discussion as to what effect the propagating material has on yield. Geneticists state that the individuals of a named variety of plants, propagated from cuttings (asexually) thru several generations and all originating from one original plant of the variety (called a clonal variety) should not differ appreciably in yield, unless influenced by cultural practices, and environment. To test this supposition in the chrysanthemums, several of the poorest and of the best plants in the fertilizer plots were selected for the stock plants. Cuttings were taken from these and grown in the beds, side by side in 1928. Table 15 gives the results of this test. Yellow Turner was the variety used, and there were 72 plants to a treatment.

Altho the best plants had an advantage on the average of 4/5 inch, this was not enough to show any marked difference in vigor. The stems on the poor plants from which the cuttings were taken were in many cases 18 inches shorter than the best plant during the 1927 flowering season. The cuttings apparently did not have any particular advantage when taken from the best plants of the previous season. Growers in general do not select their stock, and these figures show that they are not warranted in doing so. It must be remembered that the poor plants were just as disease free as the good plants. Of course, plants that are diseased in any way should never be selected for stock plants.

TABLE 15.—Value of Selected Chrysanthemum Stock Plants, 1928

Source of cutting	Average stem length, inches
Taken from poorest plants in 1927	54.0
Taken from best plants in 1927	54.8

Stock is either placed in deep flats or in a greenhouse bench or bed that is to be run cool during the winter months. As near freezing as is possible without freezing is the ideal temperature. The stock should be carried as near dormant as possible in all respects, until time to start it into active growth for the cuttings. This means that only enough water to prevent drying out should be given, that no fertilizer should be added, and that the temperature should be kept down.

Neglecting the stock plants is one of the more common mistakes that many growers have been making. It is very important to avoid this mistake.

It is impossible to state definitely the number of cuttings that can be taken from a stock plant. Some varieties throw cuttings in greater numbers than others, while one grower would get a larger number from a stock plant than another grower would get from a plant of the same variety, due to the better care given the stock.

In work on the rooting of softwood cuttings it is apparent that growth that is too soft or succulent is not as apt to root as that of a harder growth. However, very hardwooded growth does not root well. Temperature, moisture, and all other conditions under which the stock is grown for the cuttings should be such that a good even growth of firm wooded cuttings will be produced.

INSECTS AND DISEASES

Prevention of infestations of both insects and diseases is the best insurance against trouble with chrysanthemums and pompons as with the majority of greenhouse crops. Soil sterilization, preventive spraying, and good cultural practices should hold all the common troubles on these crops in check.

Chrysanthemum midge and leaf tiers are two very troublesome insects unless every precaution is taken to prevent infestation.

Leaf tiers can be held in check as follows. Have a separate house for the stock plants and when they are moved into this remove all the foliage. Continually spray the stock with arsenate of lead and fumigate with tobacco if the moths appear in any great number. After the cuttings are rooted they should be kept sprayed with arsenate of lead at weekly intervals up until the time that it would stay on the foliage until the flowers are cut, then it should be omitted. Evergreen spray controls the larvae in the young stages and does not discolor the foliage. If the larvae or worms have been held in check up to this time they will not become serious if spraying with the lead is discontinued. No injury was noted from the lead on 25 varieties of chrysanthemums and 16 varieties of pompons during the 1928 season when they were sprayed weekly from the first potting until September. The variety Mistletoe, which has been reported as susceptible to lead injury, was included in the list of varieties with no apparent injury.

The chrysanthemum midge should be prevented from becoming established as it is difficult to eradicate. Select only midge-free cuttings as shown by the absence of the galls on stems and leaves. When spraying for leaf tier with the lead, nicotine can be added which will tend to prevent infestation both of the midge and aphids. Do not bench any plants showing galls, but burn them. If they appear, when it is seen that the galls are breaking and the small flies emerging, nightly fumigations with nicotine for a month period will be found to kill the flies.

Mildew, root rot, leaf spot, and other diseases may become bad unless proper precautions are taken to prevent them. Change the soil in raised benches, and steam sterilize ground beds each year. Do not keep the soil soaked with water, tho it should be moist at all times. Do not syringe the foliage so that leaves will be damp at

TABLE 16.—Chrysanthemum Varieties, 1928

Variety	Date	Height inches	Color	Stem	Foliage	Remarks
Chatanooga	Nov. 15–30	48	White	Very good	Medium to plentiful, light green, healthy	Good, late, white, flat blossom on top
Chrysolora	Oct. 15	44	Yellow	Medium to good	Medium abundant, very healthy	Best early yellow
December Glory	Dec. 1–10	52	Pure white	Good	Medium abundant, bad chlorosis	A fair white
Detroit News	Oct. 25–Dec. 1	48	Bronze	Medium to good	Medium abundant, healthy	An odd color
Dr. Enguehard	Nov. 15	50	Bright rose pink	Poor	Medium to scarce, very healthy	A good purple
Gladys Pearson	Nov. 10–30	54	Golden bronze	Very good	Medium abundant, very healthy	A medium to bronze yellow
Glorious	Nov. 1–10	36	Lavender	Medium to good	Medium abundant to heavy, healthy	A good reliable pink, holds color
Golden Glory	Oct. 20–30	38	Yellow	Medium	Medium abundant, very healthy	Good, holds up well
Golden King	Nov. 20–30	54	Yellow	Very good	Medium, very healthy	A good deep yellow
Harvard	Nov. 15	48	Dark crimson	Medium to poor	Medium abundant, very healthy	Good red, with little merit beyond color
Indianola	Oct. 10	48	Bronze yellow	Medium	Medium abundant, healthy	A medium good bronze yellow
Louise Pockett.	Nov. 10	48	Purest white	Excellent	Abundant, very healthy	A very good white
Miss Chicago	Nov. 10	60	White	Excellent	Abundant, slightly spotted	Excellent white, blossoms hold up very well
Mrs. J. Leslie Davis	Nov. 1	48	Pink	Medium to poor	Medium to scarce, some spots	About the same as Pink Turner
Nerissa	Nov. 1	50	Rosy mauve	Medium to poor	Scarce, some spots	A medium good pink
Pink Turner	Nov. 10	52	Pink	Medium to good	Abundant and healthy	Like Turner, but fades
Rosa Raisa	Nov. 15–30	46	Light rose	Medium to good	Scarce, healthy	Wrinkled petals, odd pale yellow
Mrs. R. M. Calkins	Nov. 25–30	48	Golden yellow	Very good	Plentiful, but sunburns and spots	Good late yellow
Sun Glow	Oct. 15	48	Bright yellow	Good	Medium abundant, healthy	A very good deep yellow
Thanksgiving Pink	Nov. 20	44	Dark pink	Medium to good	Medium abundant to abundant, healthy	Very deep pink, good because of its color
Mistletoe	December	55	Creamy white	Poor	Scarce, small, poor on bottom	
Wm. Turner	Nov. 10	52	White	Very good	Good	Excellent
W. H. Waite	Nov. 20	44	Bright bronze	Good	Medium abundant, very healthy	Best bronze
Yellow Turner	Nov. 10	50	Pale yellow	Very good	Good	Excellent

TABLE 17.—Pompon Varieties, 1928

Variety	Color	Type	Date	Shoots per plant	Stem lengths	Remarks
				No.	*In.*	
Aletta	Pale pink	Pompon	October 25	15.6	18.4	Very early, pale pink
Angelo	Pale pink	Pompon	October 25	21.9	35.0	Heavy yielder, odd
Blanche	White	Anemone	November 10	10.6	34.9	Very good
Bronze Buckingham	Bronze	Single	November 10	11.3	22.2	Very good
Christmas Gold	Bright yellow	Pompon	December 10	3.2	29.0	Good late button
Golden Feather (Source d'or)	Gold	Pompon	November 15	10.9	35.1	Very good, heavy yielder
Golden Lida Thomas	Gold	Anemone	November 25	12.4	31.2	Fair anemone
Isotta	Pale bronze	Pompon	October 20	14.4	18.9	Very early bronze
Izola	Pink	Anemone	November 10	15.4	36.0	Good yielder
Jane Ingalls	Red	Single	November 10	9.1	35.7	Odd
Lustra	Lavender	Pompon	November 10	8.2	28.0	Incurved, odd
Mariana	White	Pompon	November 10	5.6	27.0	Good white, but poor yielder
Minong	White	Pompon	October 20	11.0	32.0	Heavy yielder, very early white
Mrs. Beu (Frank Wilcox)	Orange	Pompon	November 25	9.4	27.5	One of the best
Mrs. Buckingham	Rose pink	Single	November 10	9.5	21.9	Very good
Muskoka	Bronze	Pompon	November 10	5.4	38.2	Good pompon
Old Gold	Orange yellow	Single	November 10	7.5	30.0	Not outstanding
Red Wilcox (Red Beu)	Red bronze	Pompon	November 30	6.4	31.5	Not as good as Mrs. Beu
Sunshine	Deep yellow	Pompon	November 30	11.4	30.4	Good
Varsity	Yellow	Pompon	November 10	6.8	32.3	Excellent yellow, button

night, after cool weather sets in. If good growing conditions are maintained as regards to moisture of soil and air, proper temperatures and fertilization, a good healthy growth should result.

PRICES

The graph in Figure 5 shows the average prices for six of the large flower markets during the chrysanthemum season. No great differences are noted with the exception of early October, and a general trend in the 1928-29 season for the prices to be slightly higher than for 1927-28. There is generally a slightly poorer market the first two weeks in November and a better demand around Thanksgiving than the graph would indicate.

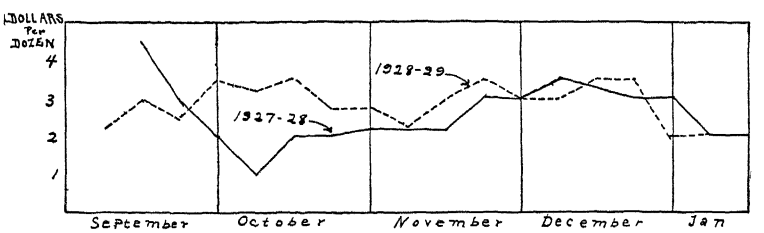

Fig. 5.—Average prices at six markets, two seasons

VARIETIES

Neither a single variety nor several varieties can be recommended in general, as the market and general growing conditions vary to a wide degree. Only by actual contact with the variety and by knowing one's own particular market demands can a grower wisely select a variety.

Gladys Pearson, Louise Pockett, Miss Chicago, and the Turners were the outstanding varieties of chrysanthemums where first class flowers of their color and season were desired.

Blanche, Bronze Buckingham, Golden Feather, Mrs. Beu, Mrs. Buckingham, and Varsity are good pompons in their types, and can be recommended for trial, along with many of the other varieties.

A general rating that was given them under the conditions at Wooster is found in the column of remarks.

CORRELATIONS

To determine what relationship, if any, stem length had to the diameter of flowers, correlations were computed on the yield of some of the 1927 plots. There were 64 plants set in each plot.

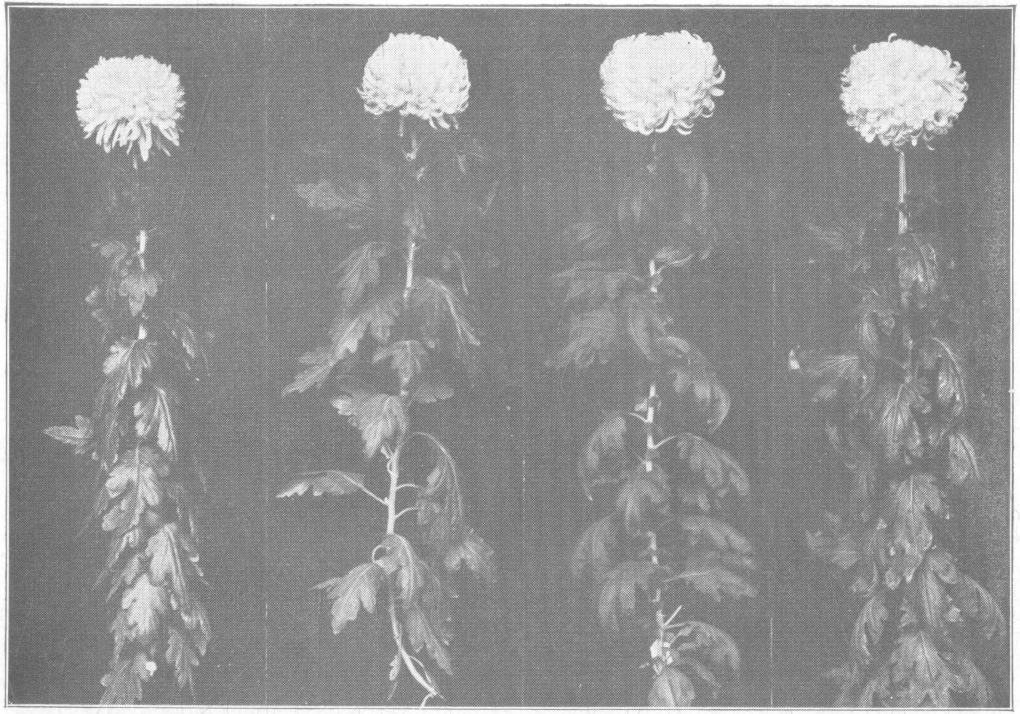

Fig. 6.—Left to right. Chrysolora, a good early yellow. Sun Glow, a deep yellow of good quality. Wm. Turner, a good midseason white. Miss Chicago, a midseason white that holds good for an unusually long time

Fig. 7.—Left to right. Bronze Buckingham, a very good single bronze. Golden Feather, one of the best gold pompons. Blanche, a good white anemone. Varsity, a good yellow button

Table 18 gives the results with four beds of William Turner and Yellow Turner. The coefficient of variability is also given for one of them.

It is readily seen from the table that there is no correlation between length of stems and diameter of blossoms. In only three of the 30 plots was the coefficient of correlation equal to four times the probably errior.

TABLE 18.—Correlation of Length of Stem vs. Diameter of Blossom

	r	Er	Coefficients of variability	
			Stem length	Diameter
Plot 1	0.044	± .150	10.46	20.91
2	.247	± .138	15.77	16.03
3	.177	± .146	22.01	23.89
4	—.119	± .152	15.22	16.85
5	.023	± .147	19.64	21.10
6	.686	± .079	39 16	20.88
7	.944	± .043	18.18	30.04
Average			20.06	21.38

Plot 1	0.155 ± .143	Plot 1	0.621 ± .074	Plot 1	0.245 ± 104
2	.403 ± .126	2	.264 ± .107	2	.054 ± 110
3	.160 ± .175	3	.350 ± .101	3	.012 ± 102
4	.155 ± .136	4	.411 ± .094	4	.161 ± 102
5	.122 ± .178	5	.082 ± .111	5	.091 ± 102
6	.140 ± .176	6	.054 ± .120	6	.136 ± 102
7	—.155 ± .182	7	.011 ± .111	7	.160 ± 104
8	.076 ± 153	.	. ...	8	.112 ± 102

Any stem growth beyond what is necessary for a good commercial flower would have no advantage.

In order that any relationship between number of shoots per plant and stem length might be determined, correlations were determined on one bed of pompons that contained 392 plants, Table 19.

TABLE 19.—Correlation of Number of Shoots vs. Length of Stem in Pompons

r	Er	Coefficient of variability	
		Number of shoots	Average stem length
0.403	± .085	31.50	37.24

These figures would indicate a slight positive correlation. Apparently the plants that had the largest number of shoots also had a tendency to have longer stems. This would at first seem opposite to expectations, but it could be due either to the greater vigor of the heavier yielding plants or the competition for light among the greater number of shoots.

SUMMARY

1. Local conditions determine to a great extent whether chrysanthemums or pompons will pay the greater return.

2. Chrysanthemum and pompon cuttings can be rooted in a number of different media, if sufficient care is given the cutting bench. Sand is very satisfactory.

3. Never allow the young plants to become pot-bound.

4. Beds gave a better growth of both chrysanthemums and pompons than that obtained in raised benches.

5. It is advantageous to renew the soil in raised benches each year. If the soil in beds is steam sterilized and the humus content renewed, satisfactory crops are secured on the old soil

6. These crops are not extremely sensitive to acid or alkaline conditions, and can be grown satisfactorily in the range of soil found in the greenhouses of Ohio.

7. Close planting within certain limits gave better returns per unit area than a greater distance between plants.

8. Early setting is advisable, particularly for the early varieties.

9. In general, terminal buds were more satisfactory than crown buds for chrysanthemums. Some early flowering varieties, however, made better flowers from the crown buds.

10. Excessive pinching of pompons is not advisable. It has a tendency to lower the quality of the shoots and cause blind growth.

11. These crops can be supported by several methods. Good straight stems however are essential for success.

12. A great deal of water is necessary in growing satisfactory crops. Moisture in the soil, and a moist atmospheric condition during hot weather is essential.

13. Temperature is hard to control but 50°-55° F. is ideal.

14. Nitrogen and humus are very important soil ingredients for chrysanthemums and pompons.

15. Peat moss gave a satisfactory growth when substituted for manure as a soil modifier.

16. None of the fertilizer treatments in the amounts used, affected the keeping quality of the flowers to any extent.

17. Do not cut chrysanthemum flowers until they are well expanded.

18. Pompons can be cut over a much wider range.

19. Chrysanthemums should be so handled that healthy cuttings are obtainable. They are often severely neglected.

20. With the proper culture and preventive measures, insect and disease troubles should not develop to serious proportions.

21. Better returns were secured for the crops early in the season, at Thanksgiving, and for the late varieties.

22. There are many satisfactory varieties of both chrysanthemums and pompons. A grower should select those that prove most profitable under his conditions.

23. There is no significant correlation between length of stem and diameter of blossom with chrysanthemums.

24. There was a slight positive correlation between length of stem and number of shoots in pompons.

25. The coefficient of variability for stem length in chrysanthemums was 20.06, and for diameter of blossoms 21.38.